Reaction Analysis of an Electrolytic Reduction Process of the ACP by Means of a Theoretical Approach

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The advanced spent fuel conditioning process (ACP) has been developed by KAERI for the purpose of reducing the volume as well as the radiotoxicity of the spent fuels (SFs) which are discharged from PWRs as oxide forms. With an electrolytic reduction (ER) process the center of the whole process, the constituents of the SF undergo chemical and physical changes through a voloxidation, an electrolytic reduction, and a smelting process and then they are separated into waste steams. However, most of the chemical transitions take place in the molten-salt-based ER process which is a main part of the ACP: electrolytic reactions producing a reductive metal and chemical reactions between the metal and the metal oxides to be reduced. Consequently, a theoretical analysis of the reactions in the ER process is indispensable for carrying out the researches on the phenomena in an electrolytic cell at a high temperature. In the ER process which uses LiCl as an electric medium and Li metal as a reducing agent, which is a product of a Li_2O decomposition by an electric potential, the activity of Li_2O is the most important property to estimate the cell potential and the extents of the reactions. In this study, an operable range of the cell potential is evaluated with a consideration of the soluble fission products (FPs) and their reaction products with LiCl in the molten salt cell and the analyses for the reactions of the constituents of the SF in the Li_2O-LiCl system are performed with the Li_2O activity.